



Guidelines for the Prevention and Treatment of Opportunistic Infections Among HIV-Exposed and HIV-Infected Children

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Preventing Vaccine-Preventable Diseases in HIV-Infected Children and Adolescents (Last updated November 6, 2013; last reviewed November 6, 2013)

Vaccines are an extremely effective primary prevention tool, and vaccines that protect against 16 diseases are recommended for routine use in children and adolescents in the United States. Vaccination schedules for children aged 0 to 18 years are published annually by the Centers for Disease Control and Prevention (see <http://www.cdc.gov/vaccines/schedules/hcp/child-adolescent.html>). These schedules are compiled from approved, vaccine-specific policy recommendations and are standardized among the major vaccine policy-setting and vaccine-delivery organizations (i.e., the Advisory Committee on Immunization Practices [ACIP], American Academy of Pediatrics, and American Academy of Family Physicians).

HIV-infected children should be protected from vaccine-preventable diseases. Most vaccines recommended for routine use can be administered safely to HIV-exposed or HIV-infected children. The recommended vaccination schedules for HIV-exposed and HIV-infected children aged 0 to 18 years correspond to the ACIP-approved schedule with ACIP-approved additions specific to HIV-infected children incorporated (see Figures 1 and 2). These schedules will be updated periodically to reflect additional ACIP-approved vaccine recommendations that pertain to HIV-exposed or HIV-infected children.

All inactivated vaccines—whether killed whole organism or recombinant, subunit, toxoid, polysaccharide, or polysaccharide protein-conjugate—can be administered safely to individuals with altered immunocompetence. In addition, because of the risks of increased vaccine-preventable disease severity in HIV-infected children, specific vaccines like pneumococcal conjugate vaccine are also recommended or encouraged for children beyond the routinely recommended ages for healthy children (if not previously administered at routinely recommended ages in early childhood); additional vaccines are also recommended, such as pneumococcal polysaccharide vaccine for children aged ≥ 2 years following receipt of pneumococcal conjugate vaccine. Similarly, before influenza vaccination was routinely recommended for children aged ≥ 6 months, trivalent influenza vaccine (TIV) was routinely recommended for HIV-infected children because of their increased risk of severe disease. TIV continues to be recommended for HIV-infected children as part of routine prevention for influenza.¹ If inactivated vaccines are indicated for individuals with altered immunocompetence, the usual doses and schedules are often recommended. However, the effectiveness of such vaccinations may be suboptimal.²

Patients with severe cell-mediated immunodeficiency should not receive live-attenuated vaccines. However, HIV-infected children are at higher risk than immunocompetent children for complications of varicella, herpes zoster, and measles—diseases for which only live vaccines are available. On the basis of limited safety, immunogenicity, and efficacy data in HIV-infected children, varicella vaccine can be considered for HIV-infected children who are not severely immunosuppressed (i.e., children with CD4 T lymphocyte (CD4) cell percentages $>15\%$ and those aged >5 years with CD4 counts ≥ 200 cells/ μL).²⁻⁴ Two doses of measles, mumps, and rubella (MMR) vaccine are recommended for all HIV-infected individuals aged ≥ 12 months who do not have evidence of current severe immunosuppression (i.e., individuals aged ≤ 5 years must have CD4 percentages $\geq 15\%$ for ≥ 6 months and those aged >5 years must have CD4 percentages $\geq 15\%$ and CD4 cell counts ≥ 200 lymphocytes/ mm^3 for ≥ 6 months) or other current evidence of MMR immunity.⁵

Limited data are available from clinical trials on the safety of rotavirus vaccines in infants known to be HIV-infected; these infants were clinically asymptomatic or mildly symptomatic when vaccinated.⁶ The limited data available do not indicate that rotavirus vaccines have a substantially different safety profile in HIV-infected infants who are clinically asymptomatic or mildly symptomatic than in infants who are HIV-uninfected. Two other considerations support rotavirus vaccination of HIV-exposed or HIV-infected infants: first, the HIV diagnosis may not be established in infants born to HIV-infected mothers before the age of the first rotavirus vaccine dose (only about 2% of HIV-exposed infants in the United States will be determined to be HIV-infected);⁷ and second, vaccine strains of rotavirus are considerably attenuated. Consultation with an immunologist or infectious disease specialist is advised for infants with known or

suspected altered immunocompetence, such as HIV-infected infants with low CD4 percentage or number, before rotavirus vaccine is administered.

For certain vaccines (such as Hepatitis A) the response to vaccination may be higher following combination antiretroviral therapy (cART)⁸ or there may be variation in immunogenicity on the basis of viral load (improved immune response with lower HIV viral load), such as with yellow fever vaccine.⁹ For other vaccines, patients with higher CD4 cell counts have improved immune response, which also means that response (e.g., to vaccination for influenza, MMR, yellow fever) likely would be improved after cART.^{1,3,9,10} For children vaccinated before taking cART, there is concern about lack of protection from pre-cART vaccines and debate about need for routine re-immunization once on effective cART.^{10,11} On the basis of low rates of measles seroprotection in children who received MMR before cART and the safety and high rates of measles seroprotection associated with MMR re-immunization once children were receiving cART,¹² the ACIP made specific recommendations for routine MMR re-immunization after cART. Individuals with perinatal HIV infection who were vaccinated prior to establishment of effective cART should receive two appropriately spaced doses of MMR vaccine once effective cART has been established (individuals aged ≤ 5 years must have CD4 percentages $\geq 15\%$ for ≥ 6 months and those aged > 5 years must have CD4 percentages $\geq 15\%$ and CD4 cell count ≥ 200 lymphocytes/mm³ for ≥ 6 months) unless they have other acceptable current evidence of MMR immunity.⁵ For some vaccines, such as for hepatitis B, ACIP recommends performing post-vaccination serology to ensure immune response.

Consult the specific ACIP statements (available at <http://www.cdc.gov/vaccines/pubs/ACIP-list.htm>) for more detail regarding recommendations, precautions, and contraindications for use of specific vaccines (<http://www.cdc.gov/mmwr/PDF/rr/rr4608.pdf> and <http://www.cdc.gov/mmwr/pdf/rr/rr5602.pdf>).^{3,4,8,13-23}

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